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CHAPTER TWENTY

COST ESTIMATING

To adequately define the project scope and to ensure that sufficient construction funds are available, construction cost estimates are required during the various stages of project development. As the project progresses, the estimate is updated to ensure the project remains cost effective, sufficient funds are available for construction, and the contractor's bid price is reasonable. Chapter Twenty discusses the various project cost estimates required and who is responsible for their preparation.

20-1.0 PROJECT ESTIMATES

20-1.01 Project Initiation Estimate

In general, the Districts are responsible for nominating projects to be included on the Department's Multi-Year Highway Improvement Program. Two notable exceptions are major improvement studies and the Interstate rehabilitation program, which are nominated by the Program Development Division. Once a project is nominated, the Transportation Programming Section is responsible for gathering the necessary project information before it can be included on the Program list. One part of this information gathering includes a preliminary cost estimate for construction. The preliminary cost estimate is generally provided by the unit which nominated the project. This estimate is generally determined using broad units of cost (e.g., cost per kilometer, cost per square meter), by the type of improvement and by reviewing similar, recent projects in the area.

20-1.02 Preliminary Engineering Study Estimate

The Preliminary Engineering Studies Section, with input from the district, will prepare a more detailed cost estimate for any project requiring an Engineer's Report. This estimate will typically be prepared with general estimating procedures discussed below (e.g., cost per kilometer, cost per square meter). However, where quantities are available, these should be used. The Preliminary Engineering Studies Section will be responsible for obtaining appropriate parametric cost estimate data.

Preliminary study cost estimates are determined according to the following.

1. Roadway Items. For most roadway items, the cost estimate is determined assuming a cost per kilometer per roadway width. This estimate reflects the cost for earthwork, pavement

structures, drainage and other miscellaneous items. Every effort should be made to include all anticipated work items.

2. Structure Items. For most structural items, the cost estimate is determined assuming a cost per square meter based on similar structure types, work type (e.g., bridge rehabilitation, replacement) and crossing type (e.g., railroad, highway, stream).
3. Traffic Signal Items. For signal installations, cost estimates are typically determined assuming a cost per intersection. For signal interconnect systems, cost estimates are typically determined assuming a cost per installation. These cost estimates will be provided by the Traffic Signal Unit.
4. Signing Items. For signs, the cost estimate is based on the number of panel signs and cost per sign. These cost estimates will be provided by the Signing and Lighting Unit.
5. Lighting Items. Most lighting is estimated assuming a cost per kilometer or per interchange where lighting will be provided. These cost estimates will be provided by the Signing and Lighting Unit.
6. Traffic Maintenance. Include an estimate for traffic maintenance on each project. This estimate is determined by parametric means with the aid of previous projects of similar size, type and complexity. For expansion and major preservation projects, traffic maintenance costs typically range from 5 to 15 percent of the roadway and/or bridge construction items.
7. Right-of-Way. Right-of-way costs for expansion and major preservation projects are furnished by the Land Acquisition Division including land cost, damages and administration costs. Right-of-way costs for other project types are generally provided by the Pre-Engineering Section based on previous land acquisition costs of similar projects.
8. Contingencies. For expansion and major preservation projects, add a contingency factor for miscellaneous and lump-sum items based on 20 to 30 percent of the roadway and/or bridge construction items.
9. Preliminary Engineering. For roadway projects, add a preliminary engineering cost of 3 to 6 percent for roadway projects based on the total of Items 1 through 8, excluding Item 7. For bridge projects, use 5 to 8 percent. The preliminary engineering cost includes environmental, survey, design and geotechnical work.
10. Unit Costs. If quantities are available, these quantities in conjunction with the average weighted unit prices from Estimator or CES are used to develop the estimate.

In addition, the user should add the cost for any major features that are beyond the basic assumptions used to develop the estimate. For example, the cost for a major box culvert should be added to the roadway cost per kilometer estimate.

20-1.03 Design Estimates

20-1.03(01) Preliminary Field Check

This is typically the first project stage where the designer is responsible for preparing the cost estimate. The total from this estimate is included in the preliminary draft of the Design Summary. At this stage, the plans should be sufficiently advanced so that some of the major quantities can be approximated. The estimate should be based on these quantities and the average weighted unit prices. After entering all known quantities into Estimator or CES, the designer should include a 10 to 25 percent contingency factor based on engineering judgment for the miscellaneous items for which the quantities have not yet been determined. If the quantities are not available, the general cost estimating procedures discussed in Section 20-1.02 should be used (e.g., cost per kilometer per roadway width). The designer should contact the Design Division's Utilities and Railroad units, and the Land Acquisition Division to obtain an estimated cost for utilities, railroads and right-of-way, unless previously supplied.

For consultant projects, the consultant will be required to use the computer program Estimator to determine the preliminary cost estimate. Section 20-2.01 discusses the Estimator program. As with CES, Estimator will provide an initial cost estimate based on the available quantities. The consultant will be responsible for adjusting the values to reflect the project type, location, environment and engineering judgment.

Some contracts may have two or more designation numbers. For example, a combination roadway/bridge contract will have multiple designation numbers. For these types of contracts, separate cost estimates are required for each designation number based on the quantities associated with that particular work category. The Contract Services Section will combine individual estimates within a single contract.

20-1.03(02) Design Approval Plans

Most major quantities should be known at this stage. However, when this is not true, the procedures described for determining the cost estimate in Section 20-1.03(01) are also applicable. Include the final total from the cost estimate in the final Design Summary. The Design Summary is submitted to the Design Division Chief for approval including the total estimated cost. Complete cost estimates are required as attachments to the Design Summary for Interstate rehabilitation projects and to the Bridge Inspection Report for bridge rehabilitation projects.

20-1.03(03) Final Check Prints

At this stage, the plans should be complete, and the preliminary cost estimate updated to a final cost estimate. All quantities should be finalized at this project stage and entered into Estimator. Section 20-2.03 provides additional guidelines for determining a cost estimate based on quantities.

20-1.03(04) Final Tracings

Before submitting the final tracings, the designer must prepare a final detailed cost estimate based on the final plans and quantities. This may be an update of an earlier cost estimate. This estimate will be used by the Contract Services Section to develop the Engineer's Estimate.

For all local public agency projects, the Contract Services Section will review the local agency's cost estimate and prepare the Department's cost estimate. This may be, but is not required to be, an independent estimate. If the difference between the local agency's cost estimate and the Contract Services Section's cost estimate is significant, the Local Transportation Section will contact the local public agency and negotiate an estimate acceptable to both parties.

If the cost estimate changes after the plans have been transmitted to the Contract Services Section due to changes in the quantities, the procedures as described in Section 14-1.02(03) and 14-1.02(04) should be followed.

20-1.03(05) Other Estimates

The following indicates where new or revised cost estimates may be required during the design stage of a project.

1. Project Scope Change. Whenever the scope of the project changes, the designer is responsible for obtaining a new construction cost estimate. Where major changes on Federal-aid projects are over \$250,000 and where construction will occur in the current or next Federal fiscal year, forward these revised cost estimates to the Transportation Programming Section so that they can revise the Multi-Year Program. Estimates for scope of work changes are typically based on approximate quantities and are determined using the procedures discussed in Section 20-1.02.
2. Project Delay. If there has been a significant delay in the project since it was originally designed and estimated, it will be necessary to update the cost estimate.

20-1.04 Engineer's Estimate

The Engineer's Estimate will provide a basis for the Department's evaluation of the bids for highway construction and will allow the Department to determine if the low bid price is fair and reasonable for the work involved. This estimate and the data used to generate the estimate are confidential and are not for general distribution.

After receiving the cost estimate, the Contract Services Section will assure that the following reviews or activities occur.

1. Review of Estimate. The Contract Services Section will review the designer's estimate and check it for errors and/or omissions. If large discrepancies are noted, they will contact the designer to discuss and resolve any differences.
2. Review of Contract Completion Time. The Contract Services Section will ensure that the cost estimate is compatible with the contract completion period set by the District construction personnel.
3. Review of Cost Estimate From Land Acquisition Division. The Contract Services Section will add cost estimates from the Land Acquisition Division to the designer's estimate to determine the final Engineer's Estimate.
4. Prepare Plans, Specifications and Estimates (PS&E). If Federally funded, the Contract Services Section will include an estimate as part of the PS&E package submitted to FHWA.
5. Review Pre-Bid Meeting Comments. The Contract Services Section will review comments at the Pre-Bid Meeting to determine their effect, if any, on the cost estimate.
6. Opening and Processing Bids. After the public reading of the bids, the Contract Services Section will check the proposals for omissions or errors. If the low bidder meets all criteria and if the low bid is within a pre-established award range, the bids are forwarded for approval.
7. Rejection of Bids. If all bid estimates exceed the pre-established award range, the bids and contracts are rejected and the re-advertising process begins. The Engineer's Estimate is reviewed with regard to the bids received.

20-2.0 ESTIMATING PROCEDURES

20-2.01 Computer Estimates

The Department uses two computer programs to help develop and track cost estimates - Cost Estimating System (CES) and Info Tech's "Estimator." CES is used internally by INDOT until the final estimate to develop preliminary cost estimates. CES is located on the Department's internal computer network system. It should be noted that CES can be imported into Estimator.

Estimator is used by consultants to determine the preliminary cost estimate. Estimator is also used by the Department's in-house and District designers. Estimator is a Microsoft Windows based program.

Each program has detailed user guide manuals that the designer should review before using the program. These manuals can be obtained from the Contract Services Section or by contacting the TRNS • PORT (BAMS) Administrator in the Information Services Division.

In order to better estimate construction costs in the future and to analyze work done in the past, more information must be entered into CES for an in-house-designed project, or into Figure 20-2A, Consultant Project Input Form, for a consultant-designed project. The additional information to be required is as follows:

1. Latitude and Longitude. This information should be taken from the SPMS project schedule. If it is not shown there, the designer or estimator should determine the location of the midpoint of the project in degrees, minutes, and seconds. However, the units symbols should be omitted. For example, 89° 59' 34'' would be entered as 895934. For an in-house design, this information is entered on the second page of the General tab. For a consultant design, this information is entered on the right-hand side of the Consultant Project Input Form.
For a contract that includes work on more than one route, e.g., guardrail repair, traffic signal bulb replacement, mowing, herbicide treatment, etc., the latitude and longitude of the point closest to the geographic center of all work should be entered.
2. rs. For an in-house design, this information should be entered on the first page of the General tab at the bottom left of the page in the block titled Metrics. For a consultant design, the values, excluding units, are entered on the left-hand side of the Consultant Project Input Form.
 - a. The project length unit is kilometer.
 - b. The pavement width is the total for the new pavement work, including paved shoulders, being done. The unit is meter. The pavement depth is the average for the new pavement work, including paved shoulders, being done. The unit is millimeter.
 - c.

work, excluding shoulders. The unit is kilometer.

Cost estimates are typically based on the quantities and applicable unit prices. CES allows the designer to enter both quantities and/or to develop cost estimates based on general estimating procedures (e.g., cost per square meter of bridge deck, cost per intersection). For Estimator, the user must input actual quantities into the program before it can generate a cost estimate. Once the quantities have been entered, the programs will automatically provide a cost estimate based on historical data from past bids. The Department is responsible for providing the base information used by the programs. This estimate may be used as is. However, the designer should review the unit costs. Based on the proposed scope for the project, the designer should be aware of factors that may influence unit prices as follows:

1. geographic location (e.g., urban/rural, State location, district);
2. similarity of recent construction projects;
3. inflation (adjustments of past prices to reflect the current year);
4. reliability of recent construction cost data;
5. recent trends in cost of materials, labor and equipment;
6. anticipated difficulty of construction;
7. project size relative to size of similar projects;
8. proposed project schedule;
9. anticipated construction staging;
10. expected environmental problems (e.g., hazardous wastes, wetlands);
11. use of experimental materials, requires coordination with the Research Division; and
12. engineering judgment.

20-2.02 Coded Pay Items

20-2.02(01) General

Each pay item has an official title and code number which is tied to the *Standard Specifications*. These items are listed in the *INDOT Catalog of Unit Price Averages for Roads - Bridges - Traffic*. This document can be obtained from the Contract Services Section. These item numbers are used by the Department for tracking and as a historic data base. For most items, CES or Estimator will provide the official pay item number. However, for some specialty or new items, the construction item may not be within the computer. Therefore, the designer will be required to conduct the following.

1. Checking. The designer should ensure that there is an actual number for the item within the system by entering the item into CES or Estimator. Do not assume the item is not in the system.

2. Specifications. The designer should review the *Standard Specifications*, Supplemental Specifications or Recurring Special Provisions to determine if there is a method of payment for the item. If not, a special provision must be developed; see Section 19-2.0.

The designer should be certain that the CES or Estimator software's pay items catalog to be used in developing the estimate of quantities and cost estimate corresponds to that which is effective for the contract letting date. Pay item names, pay units, or code numbers are periodically revised, added, or deleted. It is the designer's responsibility to check the estimating software when these changes occur, and to be certain that they are reflected in the estimate of quantities and cost estimate throughout project development.

20-2.02(02) New Pay Item and Code Numbers

If an item does not exist within the computer (CES or Estimator), the designer may request the Contract Services Section to develop a new pay item and code number. It is important for the designer to minimize this option as much as practical. It is preferred that the design be modified slightly in order to use an existing pay item. Where necessary, use the following procedure to request a new pay item and code number.

1. Request. Send or fax a memorandum requesting the new pay item to the Contract Services Section. This memorandum should include the information as follows:
 - a. the proposed pay item name;
 - b. the pay unit, both English and metric;
 - c. the applicable *Standard Specifications* section reference;
 - d. 3 copies of the special provision for the item, double spaced; and
 - e. where applicable, plan details.
2. Comments. The Contract Services Section will review the request and may solicit comments from other Department units or sections. The written request for comments will include the information as follows:
 - a. the *Standard Specifications* section number;
 - b. a copy of the special provision;
 - c. plan details, where applicable; and
 - d. the Contract Services Section's comments on the request.

Those solicited for comments will be given five working days to return their comments.

3. Response. Upon receipt of all comments, the Contract Services Section will either approve the new pay item for use and assign it a new pay item code number, or it will recommend the use of an existing pay item by developing a supplemental description for an existing specification.

20-2.02(03) Bridge Identification in Pay Item Names

A unique identifier should be assigned to each distinct bridge in the contract when required in pay item names. For a set of twin structures, each bridge should therefore be assigned a unique identifier.

20-2.03 Estimating Guidelines

For most items, CES and Estimator will provide the designer with sufficient guidance in determining the appropriate cost for a specific item. However, the designer should consider the following.

1. Unit Costs. The unit cost for most work items will be based upon an average price data base maintained by the Department within CES and Estimator, price books and unit cost bid tabulations. Adjustments to these unit prices may be appropriate based on the factors listed in Section 20-2.01.
2. Lump-Sum Items. Desirably, lump-sum items should not be used on a project. However, this is not always practical. Where necessary, only use lump-sum bid items where the scope of work for the item is clearly defined and the amount of work has a minimal chance of changing during construction. In determining the unit price for lump-sum items, the designer should consider the following.
 - a. Components. Most lump-sum items can be divided into individual parts for estimating purposes. For example, temporary traffic signal structures can be divided into the pole installation, signal heads, controller, installation, maintenance, removal, etc. Once the elements have been segregated, the designer should use engineering judgment to determine the appropriate cost for each component.
 - b. Percentages. Some lump-sum items are determined based on a percentage of the total of the contract items (e.g., mobilization and demobilization, clearing right-of-way). These are further discussed below.
3. Clearing Right-of-Way. Clearing right-of-way is typically assumed to be 1 to 2 percent of the contract items. Factors that should be considered include project location, rural or urban, the type of clearing required (trees or brush), concentration of clearing and method of disposal.

4. Temporary Bridges and Approaches. Temporary bridges and approaches should be segregated into the various components as discussed in Item 2.a. For example, temporary approaches should be determined according to the amount of embankment required, width of pavement, drainage systems, etc. Note that temporary guardrail and temporary pavement markings will be paid for separately.
5. Miscellaneous Items. The following pay items should always be included in the cost estimate.
 - a. Field Office. The field office is paid for by the month. The number of months used for final quantity and schedule of pay items is set by District Construction based on the estimated construction time.
 - b. Maintaining Traffic. Maintaining traffic is a lump-sum item and will be determined based on its various components. Elements that should be considered include traffic volumes, traffic composition, peak times, number of lanes, length of construction and type of work.
 - c. Construction Engineering. This will typically be determined by the computer. In general, construction engineering is determined using 2 percent of the total of the contract items. This may need to be revised if significant engineering may be required during construction.
 - d. Mobilization and Demobilization. This item is a lump-sum item and will typically be determined by the computer. In general, mobilization and demobilization is determined using 5 percent of the total of the contract items including the amount for construction engineering. Mobilization and demobilization costs consist of preparatory work and operations necessary for the movement of personnel, equipment, supplies and incidentals to and off the project site; for the establishment and removal of offices, buildings and other facilities necessary for work on the project; and for all other work or operations that must be performed or costs incurred when beginning or ending work on the project.
6. Other Cost Estimates. Several divisions will prepare their own cost estimates (e.g., Land Acquisition). The designer is responsible for ensuring that these divisions receive the correct information so that they can properly prepare their estimates.
7. Other. The designer should provide the Contract Services Section with any information that may influence the cost of the project (e.g., special commitments, experimental materials, special equipment, expected construction difficulties).
8. Special Materials. Contact the suppliers directly to obtain quotes for special materials. The quoted prices are typically what suppliers hope to receive for their product. The final price

the contractor will be required to pay will generally be lower due to competition and negotiations between the contractor and supplier. Such items as discounts for large quantities, early payment or extreme competition on a specific project may impact the final price. The designer should adjust the quoted prices based on these factors, previous estimates and engineering judgment.

9. Incidentals. Incidental costs cover any items that may or may not be addressed by a specific contract pay item. Incidental costs may include the following:
 - a. work included in other items by specification or special provision;
 - b. coordination with other contractors;
 - c. “tight” completion dates which demand multiple work shifts;
 - d. payment of overtime;
 - e. winter construction;
 - f. congested work areas;
 - g. high elevation work;
 - h. hauling through heavy traffic, frequent railroad crossings or traffic signals;
 - i. work not adaptable to the normal equipment used which results in manual labor or renting of special equipment;
 - j. location of plant sites, including costs of rental and renovation;
 - k. the season during which the work will be performed;
 - l. the cost of maintaining traffic including stage construction, flagmen, lights, barricades and arrow boards; and
 - m. outside agencies’ rules and regulations (e.g., OSHA, EPA).
10. Structural Plate Pipe-Arch Unit Prices Data. For a large-culvert location, the hydraulics recommendation letter will include a structural plate pipe arch sizing as well as the customary precast concrete box culvert or three-sided culvert sizing. If this occurs, the designer should evaluate both structures at the structure size and type stage and choose the more economical alternate. If the hydraulics recommendation letter includes the option of a

small- to medium-sized structural plate pipe-arch, a deformed pipe type 1 should be shown on the plans so that the contractor has the option of providing either a corrugated metal or an elliptical concrete pipe.

The Department has very little historical unit-price data for structural plate pipe-arch structures. Data from recent bid tabulations is available from the Contracts and Construction Division's Contracts Section. The designer should contact pipe suppliers for additional price information for specific sizes. Some sample price data from specific contracts is shown in Figure 20-2A.

11. Three-Sided Structures and Oversize Box Culverts Unit Prices Data. This data may be found at www.in.gov/dot/div/design/consult.htm.
12. Concrete Structural Members Unit Prices Data. Estimated unit prices for are listed in Figure 20-2B. The designer should adjust unit prices based on the quantities required for the project. The designer should increase the unit price 20 to 50 percent for small quantities. The designer should further check with a fabricator.